MSDS600 Week 4 Assignment - Nathan Worsham

The six data sets given to analyze all have one thing in common: that the Mean and Median are very close if not the same on all distributions. If there is an exception, it would be N1 and N2 whose Mean and Median are not exactly right on top of each other but still relatively very close. For the descriptive statistics of the data sets I choose to include these:

- Mean, Median, and Mode to show central tendency
- Standard Deviation to show the spread of the data
- Minimum, Maximum, and Range to show the scope
- 1st Quartile, 3rd Quartile, and Inner Quartile Range to show the dispersion less affected by outliers (Boslaugh, 2014)
- Continuous or Discrete, to characterize the data set as being made up of whole numbers or mimics a continuous set
- Number of Values to get an idea of size of the data set
- Count of Mild and Extreme Outliers along with counts at both upper and lower ends to show if there are outliers that would skew the central tendency
- Graphical representations
  - Histogram, combined when comparing
  - Boxplot, combined when comparing

To calculate many of these values I used the built-in functions of R. The exceptions would be Mode, Range, and Outliers. For mode we were provided from the reading the equation:

```
> mde <- density(data) #use these two commands to find the most frequent number
> mde$x[which(mde$y == max(mde$y))]
```

But I found that formula was not the best answer on discrete data sets. I found a function to calculate the top 10 values, being that the top value would be the mode worked better in these instances:

```
top10 <- function(x)
{
  counts <- table(x, useNA = "always")
  head(sort(counts, decreasing = TRUE), 10)
}
```

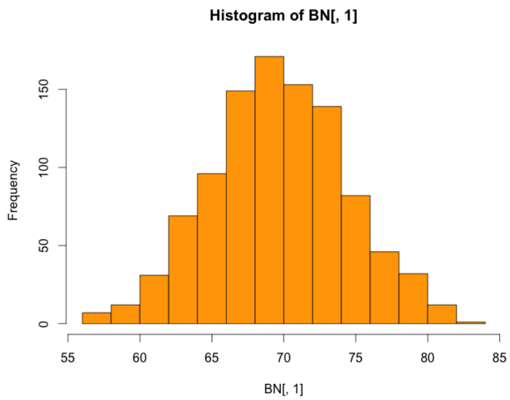
On continuous data sets, the density option worked better because the top values would often be a cluster of values with only a couple of occurrences each. To calculate range I used `max(x) - min(x)`. As for outliers, according to Boslaugh (2014) "There is no absolute agreement among statisticians about how to define outliers", however there does seem to be some guidelines that are common. One is to find "mild" outliers you multiply 1.5 times the IQR then subtract or add to the outer bounds of the IQR, and then "extreme" would be 3 instead of 1.5 (Boslaugh, 2014). To do this I created a funtion:

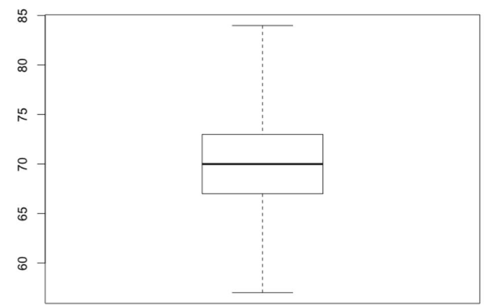
```
outliers <- function(x){
  lowerq = quantile(x[,1])[2]
  upperq = quantile(x[,1])[4]
  iqr <- IQR(x[,1])
  mild.lower.Thresh <- lowerq - (iqr *1.5)
  mild.upper.Thresh <- upperq + (iqr *1.5)
  extreme.lower.Thresh <- lowerq - (iqr *3)
  extreme.upper.Thresh <- upperq + (iqr *3)
  mild.lower.outliers <- x[,1][ which(x[,1] < mild.lower.Thresh) ]
  extreme.lower.outliers <- x[,1][ which(x[,1] < extreme.lower.Thresh) ]
  mild.upper.outliers <- x[,1][ which(x[,1] > mild.upper.Thresh) ]
  extreme.upper.outliers <- x[,1][ which(x[,1] > extreme.upper.Thresh) ]
  mild.upper.outliers.count <- length(mild.upper.outliers)
  mild.lower.outliers.count <- length(mild.lower.outliers)
  mild.outliers.count <- mild.upper.outliers.count + mild.lower.outliers.count
  extreme.upper.outliers.count <- length(extreme.upper.outliers)
  extreme.lower.outliers.count <- length(extreme.lower.outliers)
  extreme.outliers.count <- extreme.upper.outliers.count + extreme.lower.outliers.count
  print(paste0("Count of Mild Outliers: ",mild.outliers.count))
  print(paste0("Count of Upper Mild Outliers: ",mild.upper.outliers.count))
  print(paste0("Count of Lower Mild Outliers: ",mild.lower.outliers.count))
  print(paste0("Count of Extreme Outliers: ",extreme.outliers.count))
  print(paste0("Count of Upper Extreme Outliers: ",extreme.upper.outliers.count))
  print(paste0("Count of Lower Extreme Outliers: ",extreme.lower.outliers.count))
}
```

After creating this function I realized that I should have created a function to run against all of the data sets, rather than computing the values one at a time, which is something I will remember for next time. I also found that on the comparison data sets, showing the histograms and boxplots separately was much less effective then showing them combined.

Binomial.csv

paramater	value
Mean	70.17
Median	70
Mode	68
Standard Deviation	4.689325
Minimum	57
Maximum	84
Range	27
1st Quartile	67
3rd Quartile	73
IQR	6
Continous or Discrete	Discrete
# of Values	1000
# Count of Mild Outliers	3
# of Upper Mild Outliers	1
# of Lower Mild Outliers	2
# of Extreme Outliers	0

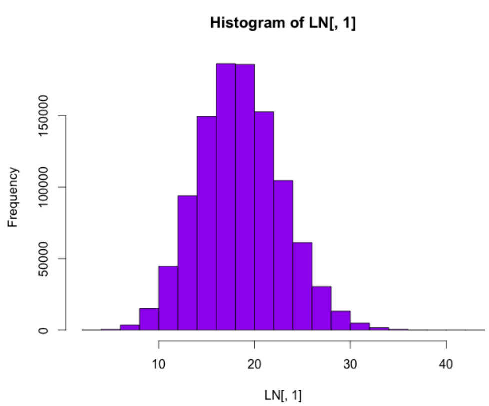


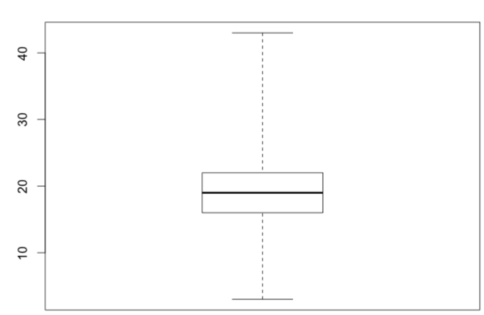


Here we see that the Mode is below the Mean and Median. The data set close to symmetrical but skewed slightly to the left. Very little outliers, even ”mild” outliers only 0.3% of total values.

ln.csv

parameter	value
Mean	18.99
Median	19
Mode	18
Standard Deviation	4.362612
Minimum	3
Maximum	43
Range	40
1st Quartile	16
3rd Quartile	22
IQR	6
Continous or Discrete	Discrete
# of Values	1048576
# of Mild Outliers	4750
# of Upper Mild Outliers	4222
# of Lower Mild Outliers	528
# of Extreme Outliers	9
# of Upper Extreme Outliers	9
# of Lower Extreme Outliers	0

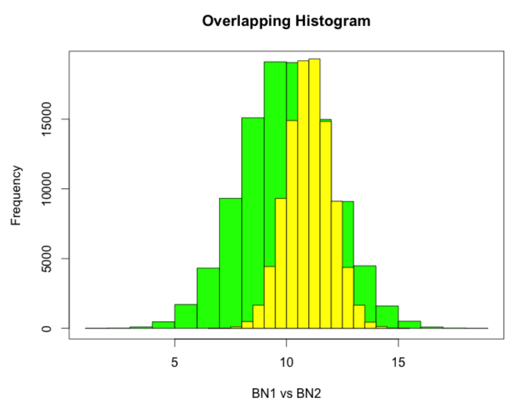


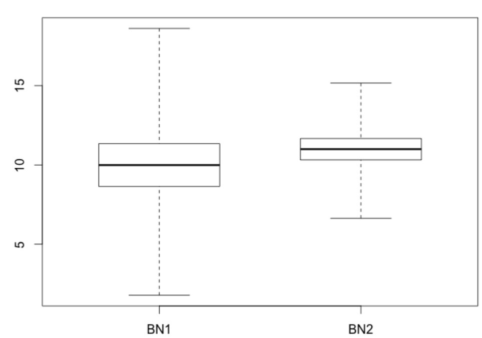


Again the Mode is below the Median and Mean and it appears there are a lot of upper outliers, but because the total number of values is so large, the outliers only account for 0.45% of the total. However this does help describe the right-skew which can be seen easier in the upper whisker of the boxplot.

BN1.csv vs BN2.csv

parameter	BN1	BN2
Mean	9.994	10.997
Median	9.993	10.998
Mode	10.07391	10.94372
Standard Deviation	2.000357	0.9994714
Minimum	1.781	6.638
Maximum	18.612	15.161
Range	16.83086	8.523442
1st Quartile	8.643	10.321
3rd Quartile	11.343	11.667
IQR	2.700128	1.345798
Continous or Discrete	Continuous	Continuous
# of Values	100000	100000
# of Mild Outliers	692	741
# of Upper Mild Outliers	357	390
# of Lower Mild Outliers	335	351
# of Extreme Outliers	0	0

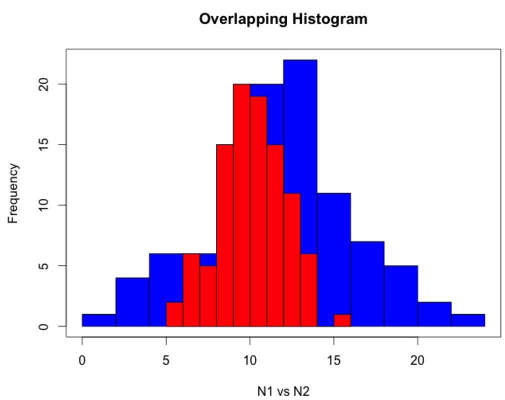


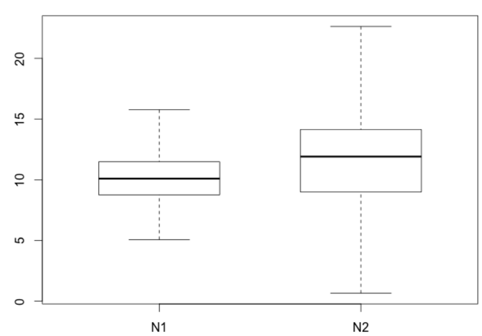


While BN1 and BN2 have Mean values that are close, BN1's range, IQR, and Standard Deviation are all wider (just about double) than BN2. BN2 is a much tighter distribution than BN1, this difference is clearly seen in the boxplot figure. In both data sets the Mean, Median are basically the exact same number while the Mode is extremely close. This would indicate very symmetrical distributions, which the histograms show.

N1.csv vs N2.csv

parameter	N1	N2
Mean	10.134	11.7082
Median	10.093	11.9056
Mode	9.960858	12.20025
Standard Deviation	1.995706	4.291276
Minimum	5.064	0.6503
Maximum	15.767	22.6275
Range	10.7026	21.97726
1st Quartile	8.774	9.0030
3rd Quartile	11.458	14.1246
IQR	2.684247	5.121644
Continous or Discrete	Continuous	Continuous
# of Values	100	100
# of Mild Outliers	1	2
# of Upper Mild Outliers	1	1
# of Lower Mild Outliers	0	1
# of Extreme Outliers	0	0





Similar to how BN1 was larger in many respects to BN2, N2 is larger than N1. It has a much wider range. N2 has several characteristics that are unusual. The Standard Deviation is comparably not that different than the Inner Quartile Range. This indicates that there is a cluster of values in the center of the distribution, but after that the values in the outer quartiles are spread apart further. The boxplot shows this well as it has long whiskers. Other notable differences is that N1's Mean is above the Median, while N2's Mean is below the Median. though the difference is minimal it would indicate the two data sets are skewed in opposite directions.

Reference

Sarah Boslaugh, 2014. Statistics in a Nutshell, 2nd Edition. Chapter 4. Descriptive Statistics and Graphic Displays.